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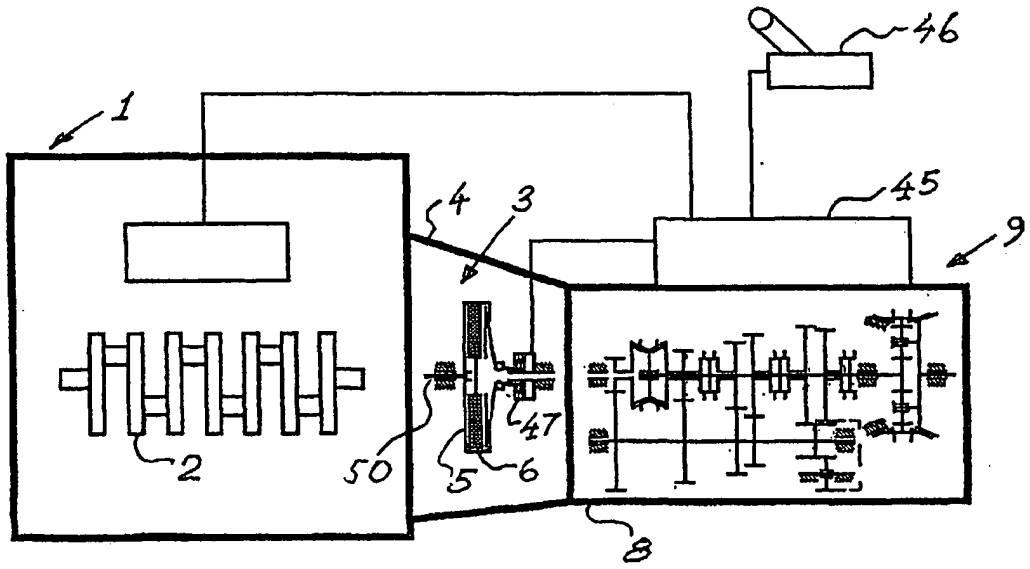
(54) Title: TRANSMISSION DEVICE FOR MOTOR VEHICLE



(57) Abstract: A transmission device in a motor vehicle, comprising an automated disk clutch (3) coupled to the output shaft (50) of an engine (1), a multi-stage gearbox (9) and a control unit for controlling the disk clutch and the engine. The control unit (45) is arranged so as, when input signals representing zero throttle are received, to give an output signal to disengage the disk clutch (3) and so as, when the throttle is subsequently opened, to give an output signal to engage the disk clutch (3) when the engine (1) has reached a rotation speed which may differ from the rotation speed of the input shaft (7) by at most a predetermined permitted speed difference.

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Transmission device for motor vehicle

The present invention relates to a transmission device for a motor vehicle, comprising an automated clutch coupled to the output shaft of an engine, a multi-stage gearbox with an input shaft which is mounted rotatably in a casing and to which the clutch is coupled, at least one intermediate shaft which is mounted in the casing and has at least one gearwheel in engagement with a gearwheel on the input shaft, a main shaft, mounted rotatably in the casing, with gearwheels which engage with gearwheels on the intermediate shaft, at least one gearwheel in each pair of intermeshing gearwheels on the intermediate shaft and the main shaft being mounted rotatably on its shaft and lockable on its shaft by coupling means. The clutch is controlled by a control unit depending on signals fed into the control unit representing various engine and vehicle data comprising at least engine speed, vehicle speed and throttle pedal position.

Automatic gearboxes of the automated multi-stage gearbox type have become increasingly common in heavy-duty vehicles as microcomputer technology has developed further and made it possible, with a control computer and a number of actuators, for example servo motors, to precision-regulate engine speed, engagement and disengagement of an automated clutch between the engine and the gearbox and also the coupling means of the gearbox in relation to one another, so that soft shifting is always obtained at the correct engine speed. The advantage of this type of automatic gearbox compared with a conventional automatic gearbox constructed with planetary gear stages and with a hydrodynamic torque converter on the input side is on the one hand that, especially as far as use in heavy-

duty vehicles is concerned, it is simpler and more robust and can be manufactured at a considerably lower cost than the conventional automatic gearbox and on the other hand that it has higher efficiency, which means lower fuel consumption is possible.

The automatic gearbox constructed from planetary gears usually has one-way clutches between the planetary gear stages, which, when the engine is driving in the automatic transmission position, lock for torque transmission from the engine to the driving wheels but which, when torque transmission takes place in the opposite direction, that is to say with zero throttle and the vehicle in motion, disengage and allow the vehicle to roll freely without engine-braking, which results in lower fuel consumption by utilizing the motive energy of the vehicle than if the engine remains engaged and brakes. It has previously been possible to obtain the corresponding freewheel function in previously known automated multi-stage gearboxes only by manual disengagement of the clutch between the engine and the gearbox.

The object of the present invention is to produce a transmission comprising a multi-stage gearbox and also an automated disk clutch of the type indicated in the introduction, which is made in such a way that an automatic freewheel function corresponding to that in the conventional automatic gearbox with planetary gear stages and overrunning clutches can be obtained.

According to the invention, this is achieved by virtue of the fact that the control unit is arranged so as, when input signals representing zero throttle are received, to give an output signal to disengage the clutch and so as, when the throttle is subsequently opened, to give an output signal to engage the clutch when the engine has reached a rotation speed which may

differ from the rotation speed of said input shaft by at most a predetermined permitted speed difference.

By disengaging the clutch, the drive line is uncoupled, so that the vehicle can roll freely without the braking effect which is otherwise obtained owing to the friction losses in the engine. In this way, a freewheel function is therefore achieved without using special overrunning clutches.

In a preferred embodiment of the transmission according to the invention, use is made, for the freewheel function, of an automated disk clutch arranged between the engine of the vehicle and the multi-stage gearbox, where the engine is equipped with an engine-braking device of, for example, the exhaust gas pressure regulator or compression brake type. In this connection, the control unit is arranged so as, when input signals representing zero throttle and engine brake switched off are received, to disengage the automated disk clutch.

In a development of the transmission according to the invention, in order to prevent a possible engine stoppage at the same time as the freewheel function is activated resulting in various servos, for example the steering and brake servos, ceasing to function by virtue of the fact that the servo pumps stop at the same time as the engine, the control unit is arranged so as, on receiving input signals which indicate that the engine is on the point of stopping and that a certain vehicle speed is present at the same time as said automated clutch (3) is disengaged, to give a signal to engage the automated clutch (3). The idling speed of the engine is normally adapted to prevailing conditions such as, for example, temperature conditions. This leads to the indication of when the engine is on the point of stopping, that is to say a minimum permitted engine speed at which freewheeling is

permitted, varying. When the clutch couples the gearbox together with the engine, the engine and servo pumps coupled to it are driven by the vehicle, so that the servo functions are maintained.

The invention is described in greater detail with reference to illustrative embodiments shown in accompanying drawings, where Figure 1 shows a diagrammatic representation of an internal combustion engine with adjacent clutch and gearbox, and Figure 2 shows the clutch and the gearbox in Figure 1 on enlarged scale.

In Figure 1, reference number 1 designates a six-cylinder internal combustion engine, for example a diesel engine, the crankshaft 2 of which is coupled to a single-plate dry disk clutch, designated generally by reference number 3, which is enclosed in a clutch case 4. The crankshaft 2 is, via the output shaft 50 of the engine, connected non-rotatably to the clutch housing 5 of the clutch 3, while its plate 6 is connected non-rotatably to an input shaft 7 which is mounted rotatably in the casing 8 of a gearbox designated generally by reference number 9. A main shaft 10 and an intermediate shaft 11 are also mounted rotatably in the casing 8.

As can be seen most clearly from Figure 2, a gearwheel 12 is mounted rotatably on the input shaft 7 and is lockable on the shaft by means of a coupling sleeve 13 which is provided with synchronizing means and is mounted non-rotatably but axially displaceably on a hub 14 connected non-rotatably to the input shaft. By means of the coupling sleeve 13, a gearwheel 15 mounted rotatably on the main shaft 10 is also lockable relative to the input shaft 7. With the coupling sleeve 13 in a central position, both the gearwheels 12 and 15 are disengaged from their shafts 7 and, respectively, 10. The gearwheels 12 and 15 engage with gearwheels 16

and, respectively, 17 which are connected non-rotatably to the intermediate shaft 11. Arranged in a rotationally fixed manner on the intermediate shaft 11 are further gearwheels 18, 19 and 20 which engage with gearwheels 21, 22 and, respectively, 23 which are mounted rotatably on the main shaft 10 and are lockable on the main shaft by means of coupling sleeves 24 and, respectively, 25 which, in the illustrative embodiment shown, do not have synchronizing devices. A further gearwheel 28 is mounted rotatably on the main shaft 10 and engages with an intermediate gearwheel 30 which is mounted rotatably on a separate shaft 29 and in turn engages with the intermediate shaft gearwheel 20. The gearwheel 28 is lockable on its shaft by means of a coupling sleeve 26.

The gearwheel pairs 12, 16 and 15, 17 and the coupling sleeve 13 form a split gearing with a low gear stage LS and a high gear stage HS. The gearwheel pair 15, 17 also forms, together with the gearwheel pairs 21, 18, 22, 19, 23, 20 and 28, 30, a basic gearbox with four forward gears and one reverse gear. Arranged in a rotationally fixed manner on the output end of the main shaft is a gearwheel 31 which forms the sun gear in a two-stage range gear of planetary type which is designated by reference number 32 and the planet-wheel carrier 33 of which is connected in a rotationally fixed manner to a shaft 34 which forms the output shaft of the gearbox. The planet wheels 35 of the range gear 32 engage with a ring gear 36 which, by means of a coupling sleeve 37, is lockable relative to the gearbox casing 8 for low range LR and relative to the planet-wheel carrier 33 for high range HR.

The coupling sleeves 13, 24, 25, 26 and 37 are displaceable as shown by the arrows in Figure 2, the gear stages shown in conjunction with the arrows being obtained. The displacement is brought about by servo devices 40, 41, 42, 43 and 44 indicated

diagrammatically in Figure 2, which can be pneumatically operated piston/cylinder arrangements of the type used in a gearbox of the type described above, which is marketed under the name Geartronic®.

The servo devices 40, 41, 42, 43 and 44 are controlled by an electronic control unit 45 (see Figure 1), comprising a microcomputer, depending on signals fed into the control unit representing various engine and vehicle data comprising at least engine speed, vehicle speed, throttle pedal position and, where appropriate, engine brake on/off, when an electronic gear selector 46 coupled to the control unit 45 is in its automatic transmission position. When the selector is in the position for manual shifting, shifting takes place at the command of the driver via the gear selector 46.

The control unit 45 also controls the fuel injection, that is to say the engine speed, depending on the throttle pedal position and also the air supply to a pneumatic piston/cylinder arrangement 47, by means of which the disk clutch 3 is disengaged or engaged.

According to the invention, the control unit 45 is programmed so that the freewheel function is activated when the driver or the cruise control no longer requests either any fuel (zero throttle) or activation of an engine brake, for example an exhaust gas pressure regulator or a compression brake. This is effected by the control unit 45 first controlling the engine speed, so that no torque is transmitted between the output shaft 50 of the engine 1 and the input shaft 7 of the gearbox 9. The control unit 45 then gives a signal to the cylinder device 47 to disengage the disk clutch 3, after which the engine 1 is controlled to an idling speed. The drive line is then uncoupled, and the vehicle can roll freely. By disengaging the disk clutch, the freewheel function is obtained irrespective of which gear is engaged in the basic gearbox.

The control unit 45 is programmed to deactivate the freewheel function when the driver requests fuel with the throttle pedal or the cruise control or requests engine-braking by, for example, activating an exhaust gas brake or compression brake. In this connection, the control unit first regulates the engine speed in toward a speed which does not differ too greatly from the rotation speed of the input shaft before the disk clutch is engaged. The drive line is then coupled together, and driving or engine-braking is possible again. If the speed difference on engagement is too great between the output shaft of the engine and the input shaft of the gearbox, the vehicle jerks. This is not acceptable in terms of comfort. Moreover, the disks in the clutch 3 wear abnormally. Other parts in the transmission are also subjected to higher stresses than normal.

Also programmed into the control unit 45 is a safety function in the event that the engine should stop when the freewheel function is activated. The safety function involves the control unit 45 giving a signal to reengage the disk clutch 3 if the engine stops during freewheeling. When the disk clutch 3 is engaged, the engine is driven by the motive energy of the vehicle, and any auxiliary sets, such as servo pumps and engine brakes, normally driven by the engine are then driven by the vehicle via the engine.

It is also possible to use types of automated clutch other than said disk clutch between the engine and the gearbox in the device according to the invention.

Patent Claims

1. A transmission device for a motor vehicle, comprising a multi-stage gearbox (9) with an input shaft (7) which is mounted rotatably in a casing (8), at least one intermediate shaft (11) which is mounted in the casing and has at least one gearwheel (16, 18) in engagement with a gearwheel (12, 15) on the input shaft, a main shaft (10), mounted in the casing, with gearwheels (15, 21, 22, 23) which engage with gearwheels (18, 19, 20) on the intermediate shaft, at least one gearwheel in each pair of intermeshing gearwheels on the intermediate shaft and the main shaft being mounted rotatably on its shaft and being lockable on its shaft by coupling means (13, 24, 25), and where the input shaft (7) is connected to an automated clutch (3) which is connected to an output shaft (50) from an engine (1) and is controlled by a control unit (45) depending on signals fed into the control unit representing various engine and vehicle data comprising at least engine speed, vehicle speed and throttle pedal position, characterized in that the control unit (45) is arranged so as, when input signals representing zero throttle are received, to give an output signal to disengage the clutch (3) and so as, when the throttle is subsequently opened, to give an output signal to engage the clutch (3) when the engine (1) has reached a rotation speed which may differ from the rotation speed of said input shaft (7) by at most a predetermined permitted speed difference.

2. The transmission device as claimed in claim 1, coupled to an engine with engine-braking means in order to increase the braking effect of the engine, characterized in that the control unit (45) is arranged so as, when input signals

representing zero throttle and engine-braking means switched off are received, to give an output signal to disengage the automated clutch (3).

3. The transmission device as claimed in claim 1 or 2, characterized in that the control unit is arranged so as, on receiving input signals which indicate that the engine is on the point of stopping and that a certain vehicle speed is present at the same time as said automated clutch (3) is disengaged, to give a signal to engage the automated clutch (3).

4. The transmission device as claimed in any one of the preceding claims, characterized in that actuating means (40, 41, 42) interact with the coupling means (13, 24, 25), which actuating means are controlled by said control unit (45).

5. The transmission device as claimed in any one of the preceding claims, characterized in that the clutch (3) is of the disk clutch type.

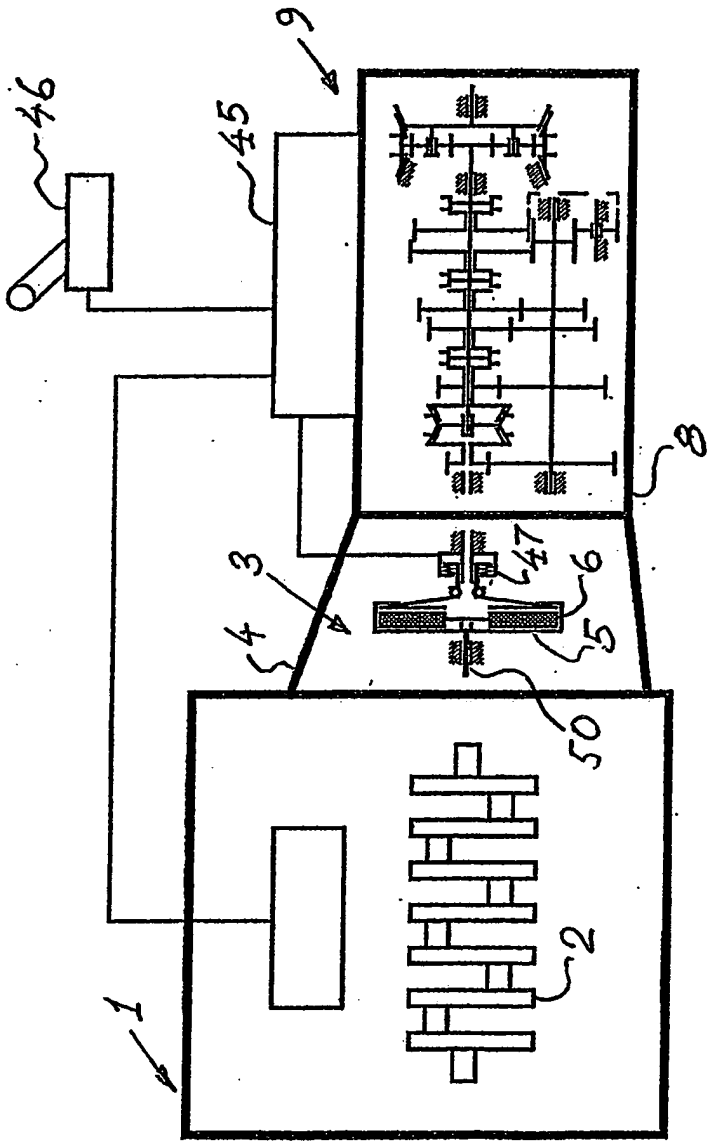

Fig. 1

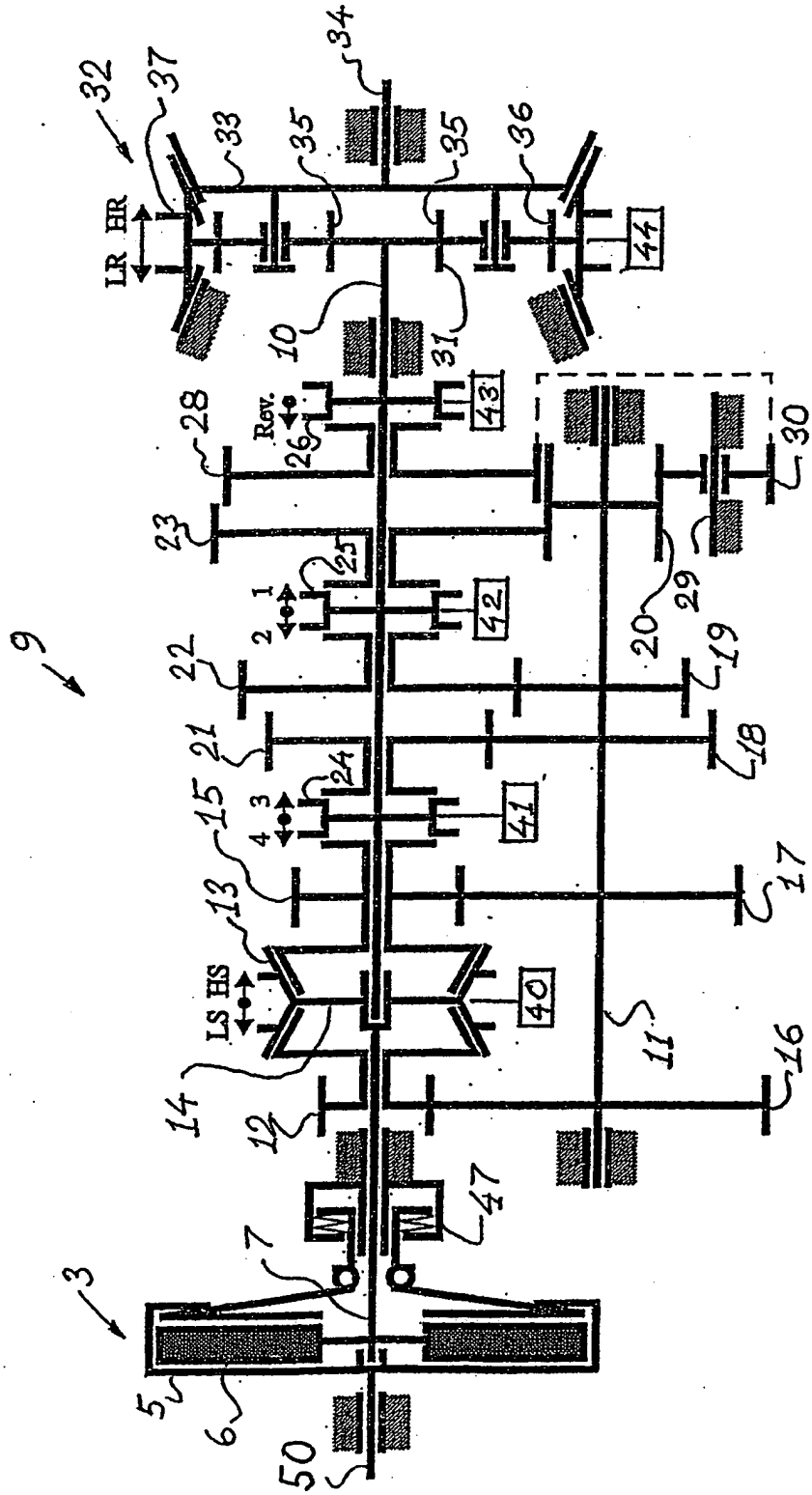
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Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/00352

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60K 41/02, B60K 41/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60K, F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 May 2003	16 -05- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Per-Olof Warnbo / MRo Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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